

CLAIMS:

What is claimed is:

1. A video encoder for encoding image frames that are divisible into
5 macroblocks, comprising:

means (130) for generating a quantization parameter (QP) estimate for the macroblocks of an image frame; and

means (130) for selection of a frame level QP for the image frame, using one of mean, median, and mode of QP estimates for the macroblocks.

10 2. The video encoder as defined in Claim 1, wherein the image frames comprise video data in compliance with the International Telecommunication Union, Telecommunication Sector (ITU-T) H.264 standard.

15 3. The video encoder as defined in Claim 1, further comprising a macroblock QP calculator (130) in signal communication with said frame level QP selection means for calculating individual macroblock QPs using the selected frame level QP.

20 4. The video encoder as defined in Claim 3, wherein said macroblock QP calculator (130) adjusts the individual macroblock QPs based on picture type.

25 5. The video encoder as defined in Claim 4, wherein said macroblock QP calculator (130) adjusts the individual macroblock QPs to maintain more details for Intra-coded pictures than for Inter-coded pictures, and to achieve lower mean square errors for the Inter-coded pictures than for the Intra-coded pictures.

30 6. The video encoder as defined in Claim 1, further comprising:
intra prediction means for intra predicting the macroblocks using a subset of allowable intra prediction modes to form predictions for the macroblocks; and
prediction residual calculating means (110) in signal communication with said intra prediction means and with said macroblock QP estimation means for calculating prediction residuals for the predictions, and

wherein said macroblock QP estimation means uses at least one of the residuals calculated by said prediction residual calculating means for generating the QP estimate.

5 7. The video encoder as defined in Claim 6, further comprising mode selection means (180) in signal communication with said prediction residual calculating means for selecting one of the modes in the subset using a mean square error of the prediction residuals.

10 8. The video encoder as defined in Claim 7, wherein the selected one of the modes in the subset provides a most accurate prediction for a current frame than other ones of the modes in the subset.

15 9. The video encoder as defined in Claim 6, wherein the subset includes three intra prediction modes.

20 10. The video encoder as defined in Claim 9, wherein the three intra prediction modes are a vertical intra prediction mode, a horizontal intra prediction mode, and a (DC) intra prediction mode.

25 11. The video encoder as defined in Claim 1, wherein each of the image frames represents a single picture, and the video encoder further comprises bit allocation means (177) in signal communication with said frame level QP selection means for allocating more target bits for pictures at a beginning of a Group of Pictures (GOP) than subsequent pictures in the GOP.

30 12. The video encoder as defined in Claim 1, wherein each of the image frames represents a single picture, and the video encoder further comprises bit allocation means (177) in signal communication with said frame level QP selection means for limiting a total number of bits allocated to a current Group of Pictures (GOP) when a previous GOP was coded with a number of bits one of below a pre-defined minimum threshold and above a predefined maximum threshold.

35 13. The video encoder as defined in Claim 12, wherein said bit allocation means (177) limits the total number of bits using a linear weighted allocation scheme.

14. The video encoder as defined in Claim 12, wherein said bit allocation means (177) limits the total number of bits based on a virtual buffer level, the virtual buffer level for simulating a fullness of an actual used buffer and being constrained in capacity with respect to the actual used buffer.

15. The video encoder as defined in Claim 12, wherein said bit allocation means (177) limits the total number of bits with respect to a minimum quality and at least one of a buffer safety top margin relating to buffer overflow and a buffer safety bottom margin relating to buffer underflow.

16. The video encoder as defined in Claim 1, further comprising virtual frame skipping means in signal communication with said frame level QP selection means for virtually skipping a next frame to be encoded when a current buffer level is above a predefined maximum threshold.

17. A method for encoding image frames that are divisible into macroblocks, comprising the steps of:

generating (225) a quantization parameter (QP) estimate for the macroblocks of an image frame; and

selecting (230) a frame level QP for the image frame, using one of mean, median, and mode of QP estimates for the macroblocks.

18. The method as defined in Claim 17, wherein the image frames comprise video data in compliance with the International Telecommunication Union, Telecommunication Sector (ITU-T) H.264 standard.

19. The method as defined in Claim 17, further comprising the step of calculating (245) individual macroblock QPs using the selected frame level QP.

20. The method as defined in Claim 19, further comprising the step of adjusting the individual macroblock QPs based on picture type.

21. The method as defined in Claim 20, wherein the individual macroblock QPs are adjusted to maintain more details for Intra-coded pictures than for Inter-

coded pictures, and to achieve lower mean square errors for the Inter-coded pictures than for the Intra-coded pictures.

22. The method as defined in Claim 17, further comprising the steps of:

intra predicting (225) the macroblocks using a subset of allowable intra prediction modes to form predictions for the macroblocks; and

calculating (225) prediction residuals for the predictions,

wherein said generating step uses at least one of the residuals calculated at said calculating step for generating the QP estimate.

23. The method as defined in Claim 22, further comprising the step of selecting (225) one of the modes in the subset using a mean square error of the prediction residuals.

24. The method as defined in Claim 23, wherein the selected one of the modes in the subset provides a most accurate prediction for a current frame than other ones of the modes in the subset.

25. The method as defined in Claim 22, wherein the subset includes three intra prediction modes.

26. The method as defined in Claim 25, wherein the three intra prediction modes are a vertical intra prediction mode, a horizontal intra prediction mode, and a DC intra prediction mode.

27. The method as defined in Claim 17, wherein each of the image frames represents a single picture, and the method further comprises the step of allocating more target bits for pictures at a beginning of a Group of Pictures (GOP) than subsequent pictures in the GOP.

28. The method as defined in Claim 17, wherein each of the image frames represents a single picture, and the method further comprises the step of limiting a total number of bits allocated to a current Group of Pictures (GOP) when a previous GOP was coded with a number of bits one of below a pre-defined minimum threshold and above a predefined maximum threshold.

29. The method as defined in Claim 28, wherein said limiting step limits the total number of bits using a linear weighted allocation scheme.

5 30. The method as defined in Claim 28, wherein said limiting step limits the total number of bits based on a virtual buffer level, the virtual buffer level for simulating a fullness of an actual used buffer and being constrained in capacity with respect to an actual used buffer.

10 31. The method as defined in Claim 28, wherein said limiting step limits the total number of bits with respect to a minimum quality and at least one of a buffer safety top margin relating to buffer overflow and a buffer safety bottom margin relating to buffer underflow.

15 32. The method as defined in Claim 17, further comprising the step of virtually skipping (220) a next frame to be encoded when a current buffer level is above a predefined maximum threshold.

20 33. A video encoder (100) for encoding image frames that are divisible into macroblocks comprising a quantizer (130) for generating a quantization parameter (QP) estimate for the macroblocks of an image frame and for selection of a frame level QP for the image frame, using one of mean, median, and mode of QP estimates for the macroblocks.